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Beyond promotion-based store switching: Antecedents and patterns of systematic multiple-store shopping

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Beyond Promotion-Based Store Switching:

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Abstract

In this paper, we demonstrate both theoretically and empirically that single-purpose multiple store shopping is not only driven by opportunistic, promotion-based motivations, but may also result from a longer term planning process based on stable store characteristics. We find that consumers may systematically visit multiple stores to take advantage of two types of store complementarity. In the case of 'fixed cost complementarity', consumers alternate visits to high and low fixed cost stores to balance transportation and holding costs against acquisition costs. 'Category preference complementarity' occurs when different stores offer the best value for different product categories, and may induce consumers to visit these stores together on combined shopping trips. In both cases, multiple store shopping leads to a shift from share-of-customers to share-of-wallet retail competition.

Key words: multiple store shopping, store choice, spatial competition

1. Introduction

One of the most important trends characterizing today's grocery retail business is the massive rise in multiple store patronage (Kahn & McAlister, 1997). Rather than passively revisiting the same store – out of habit or due to an aversion to change - consumers actively exploit the opportunities offered by a differentiated retail environment by visiting two or more stores on a regular basis. In fact, strictly store loyal consumers have become the exception rather than the rule. A recent survey by Progressive Grocer (2004) indicates, for instance, that 75% of all grocery shoppers regularly visits more than one store each week (Stassen, Mittelstaedt & Mittelstaedt, 1999). Similar figures are reported in Fox and Hoch (2005) and Drèze and Vanhuele (2006).

The marketing literature has typically viewed grocery store switching as evidence of opportunistic cherry picking behavior, consumers switching stores to benefit from temporary promotional offers (Lal & Rao, 1997; Bell & Lattin, 1998; Drèze, 1999; Fox & Hoch, 2005). There is a growing belief, however, that multiple store shopping cannot be ascribed to price promotions alone (Popkowski-Leszczyc & Timmermans, 1997; Krider & Weinberg, 2000). First, the stability and regularity of multiple store shopping patterns reported in recent papers does not fit in with the picture of cherry picking consumers selecting stores on the basis of temporary 'best deals' (Galata, Bucklin & Hanssens, 1999; Rhee & Bell, 2002). Second, the fraction of consumers who decide where to shop on the basis of feature ads is found to lie in the 10-35% range (Urbany, Dickson & Kalapurakal, 1996; FMI 1993) - far below the fraction of shoppers who regularly visit multiple stores (about 75%, see above). Empirical evidence that sales promotions induce store switching and enhance store sales also remains limited (Rhee & Bell, 2002; Srinivasan, Pauwels, Hanssens & Dekimpe, 2004). This suggests that consumers may systematically visit multiple stores for reasons other than promotional offers.

In this paper, we study non-promotional motives for multiple store shopping. To improve our understanding of systematic multiple store shopping (MSS) and its implications, we develop a formal model that integrates insights from the marketing and geographical literature. In addition to shopping costs, we explicitly account for differences in fixed and variable shopping benefits between different stores. We also incorporate shopping pattern (single, separate, combined store visits) and related shopping decisions (store visit frequency, product category allocation).

Our paper contributes to the available literature in several ways. We offer two main substantive insights. First, we show that, even in the absence of temporary promotional offers, consumers may have good reasons to patronize more than one grocery store. More specifically, we demonstrate that consumers may systematically allocate their purchases over two or more stores to take advantage of two types of store complementarity: (i) *fixed cost complementarity* (stores with the lowest fixed costs - such as transportation and in-store costs – have higher variable costs) and/or (ii) *category preference complementarity* (one store is preferred for a subset of categories, another store for the remaining categories). Second, we link consumers' motives for visiting multiple stores with their shopping trip organization, i.e., whether different stores are visited on the same or separate shopping trips. This, in turn, affects how category purchases are allocated across stores.

Moreover, while previous studies on stable store choice and shopping pattern decisions mostly relied on simulation analyses, we provide an empirical validation of our model and its results using panel data covering household purchases in a wide variety of stores. In addition to providing support for our theoretical model, the empirical analysis allows to assess complementarity relationships between these stores.

From a managerial perspective, we shed new light on the nature of competition between retail chains. For one, when store complementarities encourage consumers to visit multiple stores, retailers may shift their focus from 'share-of-customers' competition to 'share-of-wallet' competition, trying to maximize their share in categories where they exhibit relative strengths based on their fixed or variable cost position. Our results also indicate that a close location to competitive stores can be a threat or an asset depending on the type of complementarity. With fixed-cost complementarity, the low fixed-cost store loses its advantage as distance to the complementary (high fixed cost) store declines. In contrast, close location to a category-preference-complementary store may actually benefit chains, allowing them to 'team up' against more remote competitors with an appealing offer across-the-board.

The discussion is organized as follows. Section 2 provides a brief overview of related literature on store choice and shopping pattern decisions. In section 3, we present a conceptual framework describing the shopping decision process. Building on this framework, we develop a mathematical shopping decision model, and discuss its implications for optimal store and shopping pattern selections. An empirical model is presented in section 4. Section 5 provides an overview of the major conclusions, while section 6 contains limitations and interesting areas for future research.

2. Related literature

Our paper builds upon two main streams of literature: the marketing literature on store choice models, and the predominantly geographically oriented literature on multipurpose shopping and spatial interaction models (see Table 1 for an overview of key papers).

<insert Table 1>

Marketing papers on store choice mostly concentrated on single purpose shopping (Table 1, Panel a), where consumers face a choice between competitive stores that offer essentially similar assortments. These papers model the consumer's selection of a retail outlet at a given point in time (single shopping trip), typically assuming that consumers select the store that provides the maximum shopping utility and assign their entire shopping basket to this store (see e.g. Bell, Ho & Tang , 1998). Within this setting, shifts in store patronage over time are especially related to changes in the consumer's shopping list and other situational factors - such as promotions – that affect the consumers' variable shopping costs.

A few marketing papers have relaxed this focus on single store selection. Messinger and Narasimhan (1997), Galata, Bucklin & Hanssens (1999) and Fox, Montgomery & Lodish (2004), for instance, developed predictive and normative models of how store price differences affect store format selection. In this framework, consumers may visit EDLP as well as HiLo stores on a regular basis to combine advantages of lower regular prices (EDLP stores) with occasionally offered, sharp promotional price cuts (HiLo stores). However, as specials are typically offered at random points in time, and given that empirically observed store switching effects are not overwhelming, additional forces must underlie systematic multiple store visits for groceries. In an exploratory analysis of consumers' shopping behavior across and within retail formats, Fox et al. (2004) find that - besides promotions – stable store format features such as assortment and accessibility do affect multiple store patronage. Their results also suggest that consumers' preferences for alternative formats are interrelated. Based on these findings, the authors call for research that sheds more light on the complementarity and substitutability of stores in different formats, accounting for consumers' 'higher-order shopping strategies'.

The latter issues received widespread attention in the geographically oriented literature on multi-purpose shopping (Ghosh & McLafferty, 1984; Ingene & Ghosh, 1990; Dellaert, Arentze, Bierlaire, Borgers & Timmermans, 1998, Popkowski-Leszczyc & Timmermans, 2001; see Table 1, Panel b). In these papers, multiple store shopping is seen as the outcome of shopping location choices, taking into account more than one shopping purpose or need. Often, not all locations can satisfy the full set of purchase needs (e.g. groceries as well as shoe repair services). In such cases, purchases may be systematically allocated to different shopping locations depending on whether other, complementary shopping tasks have to be fulfilled on the same shopping trip. For instance, consumers will buy their groceries on a different (often more remote) location when they also need to visit a shoe repair shop. Buying frequently purchased products such as groceries at different locations helps reduce transportation and holding costs, and hence minimize overall shopping costs.

A key question is to what extent insights from multipurpose studies remain relevant when consumers have only a single purpose – buying groceries. In the above- mentioned papers, multiple store shopping arises because some locations only carry a subset of product categories. While this assumption is valid for multi-purpose shopping trips, it may not hold for single-purpose shopping trips. An interesting study by Krider and Weinberg (2000) indicates that a trade-off between fixed and variable shopping costs can also motivate consumers to visit multiple stores in a single purpose shopping context - where stores offer the same types of products. To reduce overall shopping costs, consumers may decide to buy perishable (high holding cost) products predominantly in nearby (possibly less preferred) stores, while fulfilling the bulk of their other product needs in more distant (but more preferred) stores. Yet, in Krider and Weinberg's analysis, price/quality differences across chains are the same for all categories and only the effect of storage cost differences between categories intervenes, leaving other potential motivations for MSS uncovered.

In sum, while providing relevant insights, the literature to date leaves us with a challenging research issue: to explore the reasons behind, and the strategic consequences of, systematic multiple store shopping in a single purpose context, where consumers face a variety of store chains with the same categories but with different benefits and costs.

3. Single-purpose multiple-store shopping

3.1. Conceptual framework

Figure 1 summarizes our conceptual framework, which extends the available literature in several ways. In line with Bell et al. (1998), we assume that consumers minimize overall (fixed and variable) shopping cost when making their shopping decisions. However, while Bell et al. (1998) focus on trip-based *store choice* decisions, we focus on stable shopping decisions, including not only the choice of specific stores, but also the selection of a *shopping pattern*. In line with the multi-purpose shopping literature (see e.g. Popkowski Leszczyc & Timmermans 2001), we distinguish between the following three generic shopping patterns[1]:

(I) Single Store Shopping Pattern: here, the consumer always visits the same store

(II) Separate Store Shopping Pattern: the consumer patronizes multiple stores, but visits only one store on each shopping trip.

(III) Combined Store Shopping Pattern: the consumer patronizes more than one store on each shopping trip.

<insert Fig.1>

Store and shopping pattern decisions are not made in isolation but also depend on related shopping decisions (see e.g. Popkowski Leszczyc, Sinha 2000). For this reason, our model also incorporates

[1] In reality, stable shopping patterns may consist of a mix of these generic patterns, such as a combination of separate and combined multiple store shopping trips For simplicity of exposition, the following discussion concentrates on the three 'pure' shopping patterns (either single, separate or combined visits). Similar analyses for mixed shopping patterns (consumers alternating between separate and combined visits) point out that the underlying motivations are a combination of those for 'pure' patterns. As explained in more detail in the online appendix, the shopping behavior model presented in the following section can be adjusted to accommodate these mixed shopping patterns.

both *store visit frequency* decisions (the number of shopping trips to each store during the planning period) and *category allocation* decisions (share of category purchases allocated to each of the visited stores) (see right panel of Figure 1). The interrelationship between these shopping decisions will be clarified in more detail in the next section.

When making these decisions, consumers trade off several types of shopping benefits and costs (see central box in Figure 1). Based on the spatial interaction model literature (Ghosh & McLafferty, 1984; Bawa & Ghosh, 1999), we specify the consumer's shopping decision process as a cost minimization problem, and include three types of *costs*: (i) acquisition costs or variable shopping costs (the amount paid to acquire the products), (ii) handling and holding costs (costs of handling and storing the products at home), and (iii) transaction costs or fixed shopping costs (transportation costs and in-store costs, stemming from the time and effort to go to the store, walking through the aisles and waiting at the checkout). While acquisition and holding cost depend on the level of demand, transaction/fixed shopping costs are incurred – independent of the demand level - each time a shopping trip is made.

In addition, building upon the marketing-oriented shopping studies (Tang, Bell & Ho, 2001), we account for variable and fixed shopping *benefits:* (i) consumption benefits (the utility of consuming the products, which is related to the store's assortment), and (ii) fixed in-store benefits (the pleasure derived from the shopping act, which, for instance, is enhanced by store ambience and service level, Berman & Evans, 1999; Tang et al., 2001).

Given our interest in systematic multiple store shopping, we focus on equilibrium shopping patterns, based on *stable* benefits and costs (see Krider & Weinberg 2000; Galata et al., 1999; Ghosh & McLafferty, 1984; Ingene & Ghosh, 1990 and Bawa & Ghosh, 1999 for a similar approach). As indicated in the left panel of Figure 1, the level and importance of these benefits and costs will depend on store characteristics (such as size, accessibility, service level), product category characteristics (like demand and storage cost), and the interaction between them (e.g. differences in price, quality and assortment). Concentrating on these stable shopping factors allows us to isolate the phenomenon of systematic MSS.

3.2. Shopping behavior model

In this section we model the consumer's shopping cost function. Let s be a store indicator, and p a product category indicator. Like Ghosh and McLafferty (1984) and Fox and Semple (2002), we assume that a consumer's shopping pattern includes at most two stores ($s=s_1,s_2$). For simplicity of exposition, we also present our model and results for two product categories ($p=p_1,p_2$), a condition that will be relaxed in the empirical section. Consistent with our focus on single-purpose shopping, we assume that each category can be bought in each store, thereby relaxing the traditional assumption made in the multi-purpose shopping literature that one of the product categories can be bought in one of the stores (shopping destinations) only. Like previous shopping pattern studies, we assume that category demand is given (i.e., based on household needs and independent of product prices) and is uniformly spread over time (see e.g. Bhatnagar & Ratchford, 2004).

Building on Ghosh and McLafferty's (1984) spatial interaction model, we propose the following expressions for the consumer's total shopping cost during a specified planning horizon (to avoid notational burden, we omit the consumer superscript):

For shopping patterns involving a single store s_1 only (pattern I):

$$TC_{I,s1} = \sum_p [VC_{p,s1} D_p + S_p D_p / 2N_{s1}] + t_{s1} N_{s1} \tag{1a}$$

For consumers visiting two different stores (s_1 and s_2) on separate shopping trips (pattern II):

$$TC_{II} = [\sum_{s=s1,s2} (\sum_p (\alpha_{II,p,s} VC_{p,s} D_p + \alpha^2_{II,p,s} S_p D_p / 2N_{s,p}) + t_s N_s)] \tag{1b}$$

For shopping patterns involving combined trips to stores s_1 and s_2 (pattern III):

$$\begin{aligned} TC_{III} = [&\sum_p (\alpha_{III,p,s1} VC_{p,s1} D_p + \alpha_{III,p,s2} VC_{p,s2} D_p) + \\ &\sum_p S_p D_p / 2N_{s1s2} + t_{s1s2} N_{s1s2}] \end{aligned} \tag{1c}$$

where

TC = total shopping cost per period (i.e., the consumer's planning horizon)

$\alpha_{p,s}$ = fraction of category p's demand purchased in store s

$VC_{p,s}$ = net variable shopping cost per unit for category p in store s

D_p = demand per period for category p

S_p = storage cost per unit of category p per period

N_s (N_{s1s2}) = number of shopping trips per period to store s (combined trips to stores s_1 and s_2)

$N_{s,p}$ = number of shopping trips per period to store s on which category p is purchased

t_s(t_{s1s2})= net fixed shopping cost per trip to store s (per combined trip to stores s_1 and s_2),

and the subscripts I, II and III refer to single, separate, and combined shopping patterns, resp.

In each of these expressions, three cost types intervene:

- The first is the *total net variable shopping cost* over the planning period, which depends on the consumer's category demand (D_p) and on how category purchases are allocated across stores ($\alpha_{p,s}$). The net variable shopping cost for a *unit* of category p in store s ($VC_{p,s}$) is specified as the difference between price ($P_{p,s}$) and quality/consumption benefits ($Q_{p,s}$) per unit of category p bought in store s.
- The second term captures the total *holding costs* over the planning period. If all category purchases are made in a single store s (pattern I), the average inventory level is equal to $D_p/2N_s$ and the total holding cost for the category amounts to $S_p * (D_p/2N_s)$ [2]. With combined shopping patterns (pattern III), all categories are still purchased during the same shopping *trip*, such that the holding cost expression remains the same as for the single store strategy. In case of separate store visits, however, the holding cost function becomes more complex. Specifically, when only a fraction $\alpha_{p,s}$ of category p's demand is purchased in store s, holding costs for these purchases have to be corrected for (i) the lower amount bought in store s ($\alpha_{p,s} * D_p$ instead of D_p), and (ii) the fact that the acquired products have to be stored during only a fraction $\alpha_{p,s}$ of the planning period. Like Ghosh and McLafferty (1984), we further rely on the assumptions that (i) customers who visit different stores on separate shopping trips deplete the inventory of one store's products before making purchases of the same product category in a different store, and (ii) the number of store visits to one store is an integer multiple of the number of visits to the other. Under these

[2] Like Krider and Weinberg (2000), we specify unit holding cost as independent of purchase price. For groceries, this seems like an acceptable assumption, since (i) price differences between stores and (ii) financial investments in these products (absolute price levels) are low. Note that our S_p does vary by product category. Allowing holding costs to vary with store price differences would make the derivations more complex, but would not alter the essence of our findings.

assumptions, holding costs per category and store in the separate store shopping strategy (II) amount to $\alpha^2_{p,s} * S_p * D_p / 2N_{s,p}$ [3] (Ghosh & McLafferty, 1984).

- The third term represents *the total net fixed shopping costs*, specified as the number of trips (N_s) times the net fixed costs incurred per trip (t_s). The latter is obtained by subtracting the in-store benefits from the transportation and in-store cost of one visit. The fixed cost of a combined trip to stores s_1 and s_2 (t_{s1s2}) is a function of the fixed cost of a trip to each of the separate stores. Given that the transportation cost for a combined trip comprises the cost of a 'one-way journey' to s_1 and s_2 plus the cost of travelling from s_1 to s_2, combined shopping trips may allow to reduce transportation costs, especially when the distance between both stores is small.

In brief, shopping cost functions (1a)-(1c) have three distinguishing features. First, they combine benefits and costs into 'net costs', thereby generalizing previous cost functions in the spatial interaction model literature. Second, they allow for single as well as multiple store shopping in a single purpose (grocery) context where all categories are available in all stores. Third, in case of multiple store shopping, they allow for category purchases to be allocated to different stores, which may be visited on separate or combined shopping trips.

3.3. Optimal shopping pattern selection

In this section, we describe the conditions for MSS to be optimal and provide an intuitive explanation of the underlying motivations. Details on how these results were derived can be downloaded from http://www.econ.kuleuven.be/katia.campo or can be obtained from the authors on request.

As indicated in section 3.1, we assume that consumers select the shopping pattern with the lowest total shopping cost as specified in equations (1a)-(1c). Table 2 presents, for each shopping pattern type, the store visit frequencies (N_s or N_{s1s2}, first column) and category allocations ($\alpha_{p,s1}$, second column) that jointly minimize the total shopping cost for that pattern (third column). In these

[3] Unlike Ghosh and McLafferty, we use $N_{s,p}$ (the number of visits to store s on which category p was purchased) rather than N_s (total number of visits to store s) in the denominator of the expression. The reason is that when purchases of several categories are allocated to more than one store (a situation not considered by Ghosh and McLafferty), consumers must align the timing of store visits across the different categories, and may find it optimal not to purchase the category on each visit to the store (see online appendix for more information).

‘minimum cost’ expressions, the first term captures fixed plus holding costs, while the remaining terms cover variable shopping costs. These optimal cost expressions allow us to identify when different types of MSS may prevail, that is, may entail the lowest total shopping cost.

Specifically, we find that the potential for MSS critically depends on two elements: (1) differences in the stores’ fixed costs per visit, and (2) the pattern of ‘category-specific store preferences’, measured as category differences in variable costs weighted by the inverse of holding cost (referred to as weighted variable costs hereafter; for a formal definition see Table 3). These elements can lead to two different types of store complementarity, underlying distinct patterns of MSS. Figure 2 provides an overview.

Fixed cost complementarity. Two stores are said to be ‘fixed cost complements’ if they (i) differ in fixed costs per visit (e.g. because one store is closer or more pleasant to shop in), *and* (ii) exhibit category preference asymmetry – one store being preferred over the other for both categories, but the weighted cost advantage being larger for one category than for the other. This may result in a ‘total cost conflict’, where visiting one store entails lower fixed costs, and visiting the other lower variable costs. Under such conditions, systematically patronizing both stores on *separate shopping trips* may provide a low-cost compromise solution. In this shopping pattern, the consumer alternates visits to the high fixed-cost store (where products are offered at good-value-for-money) with (several) in-between visits to the low fixed-cost store (where the variable costs are less appealing). These in-between visits will be used to replenish inventory for high-holding cost categories, till the next major (high fixed-cost store) shopping trip. The total cost of this separate-visit MSS pattern *may* be lower than that of each of the single store strategies if the high fixed-cost store offers a larger variable cost advantage in the low holding cost categories. Combined MSS, in contrast, will not be an optimal strategy with this type of complementarity, as it would entail higher fixed shopping costs with no reduction in variable shopping costs (see online appendix for more details).

Category-preference complementarity. Two stores exhibit category preference complementarity when one store is preferred over the other for one product category, while the other store offers better value-for-money (lower weighted variable costs) for the second category. Category preference complementarity provides a motive to visit both stores on *combined* shopping trips, which allows the household to purchase each product exclusively in its preferred store, and hence generate a substantial decrease in total variable shopping costs. Yet, this advantage will have to be weighed against the higher fixed costs of combined trips (which crucially depend on the distance between both stores) and against the associated increase in holding costs (triggered by fewer combined visits). We show that combined MSS patterns are more likely to be the lowest-shopping cost strategies if the stores are located closely together and demand is sufficiently high. Alternatively, with category preference complementarity, consumers may also choose to systematically visit the two stores on *separate* trips spread in time. In this scenario, a product will be predominantly bought in the preferred store, but some replenishment may take place upon visits to the less-preferred store. This separate visit approach entails somewhat higher variable costs than the combined strategy but possibly lower fixed plus holding costs (see online appendix for details).

<insert Tables 2 and 3, Fig.2>

The two types of complementarity constitute necessary conditions for MSS to be optimal. As long as stores have uniform category-specific store preferences (one store offers the same weighted variable cost advantage over the other store for all categories), the best approach will always be to patronize only one store. Moreover, stores with the same fixed costs will never co-occur in MSS patterns unless they are category preference complements. It is also interesting to underline that the complementarities give rise to two generically different motives for MSS. With fixed cost complementarity, MSS intends to 'balance' the high fixed-plus-holding cost of *one* single store strategy, against the high variable shopping cost of the *other*. With category preference complementarity, the incentive behind multiple store patronage is to reduce variable shopping cost compared to each of the single store strategies, while keeping fixed holding and shopping costs low[4].

[4] Note that Krider and Weinberg's (2000) results can be considered to be a special case of this MSS situation. Indeed, although Krider and Weinberg do not account for category preference complementarity (in their analysis, one store – the discounter – has lower net variable costs for all categories), category preference asymmetries are built in into their model through the holding costs. As can be seen from Table 3, the higher storage cost for perishable products implies that with $VC_{p1,s1} - VC_{p1,s2} = VC_{p2,s1} - VC_{p2,s2}$, $I_{p2,s1-s2}$ can still be smaller in absolute value than $I_{p1,s1-s2}$ when $S_{p2} > S_{p1}$, p_2 being the perishable product and s_2 the more expensive regular store. As demonstrated by Krider and Weinberg, this may lead consumers to buy part of their purchases in the preferred store s_1 (in their case, the discounter), while making fill-in trips for the higher storage cost good (the perishable product) in the 2nd preference store (the regular store).

4. Empirical Analysis

To empirically validate our theoretical developments, we estimate a multinomial logit MSS model. In contrast with previous store choice models, this model does not concentrate on single store choices at a particular moment in time, but on joint and stable selections of (i) a shopping pattern (single, separate or combined) and (ii) a store (single shopping pattern) or set of two stores (separate or combined shopping pattern). As indicated in the previous section, we assume that consumers will opt for a combination of shopping pattern and store choice(s) that minimizes overall shopping costs. These overall shopping costs constitute the systematic utility component of our shopping choice model (included in negative form, like in Bell et al. 1998): $-TC^h_{I,s_i}$ (for a single store pattern I involving store s_i), $-TC^h_{II,(s_i,s_j)}$ (for a separate-trip pattern II involving the set of stores (s_i,s_j)), and $-TC^h_{III,(s_i,s_j)}$ (for selecting the set of stores (s_i,s_j) in a combined-trip pattern III):

$$P^h_{I,s_i} = \frac{\exp(-TC^h_{I,s_i})}{\sum_{s_k}\exp(-TC^h_{I,s_k}) + \sum_{(s_k,s_l)}\exp(-TC^h_{II,(s_k,s_l)}) + \sum_{(s_k,s_l)}\exp(-TC^h_{III,(s_k,s_l)})} \tag{2a}$$

$$P^h_{II,(s_i,s_j)} = \frac{\exp(-TC^h_{II,(s_i,s_j)})}{\sum_{s_k}\exp(-TC^h_{I,s_k}) + \sum_{(s_k,s_l)}\exp(-TC^h_{II,(s_k,s_l)}) + \sum_{(s_k,s_l)}\exp(-TC^h_{III,(s_k,s_l)})} \tag{2b}$$

$$P^h_{III,(s_i,s_j)} = \frac{\exp(-TC^h_{III,(s_i,s_j)})}{\sum_{s_k}\exp(-TC^h_{I,s_k}) + \sum_{(s_k,s_l)}\exp(-TC^h_{II,(s_k,s_l)}) + \sum_{(s_k,s_l)}\exp(-TC^h_{III,(s_k,s_l)})} \tag{2c}$$

where P^h_{I,s_i}, $P^h_{II,(s_i,s_j)}$ and $P^h_{III,(s_i,s_j)}$ are the probability for a single-store pattern with store s_i, a separate-trip pattern with stores (s_i,s_j), and a combined-trip pattern with stores (s_i,s_j) resp.

4.1. Data and Operationalizations

Household and Store selection

To estimate the model, we use a scanner panel data set provided by GfK, comprising store visit and category purchase data for a random subsample of GfK's national household panel. We include the top 12 national chains, which account for about 90 % of the market sales value and 87 % of total store visits (see Table 5), and retain only households for whom at least 80% of their grocery purchases occur in these stores. In addition, we restrict the consideration set to the seven stores most closely located to the household's home. Previous studies have demonstrated that consumers seldom include more than 7 stores in their consideration set (Fox et al., 2004: 6 store chains; Bell et al. 1998: 5 supermarkets; González-Benito, Bustos-Reyes & Muňos-Gallego 2007: 7 stores), and that distance is the primary criterion for choice set delineation (Sinha, 2000; Fox et al., 2004, González-Benito et al., 2007). In all, our data set contains information for 906 households and 12 grocery chains (representing four different store formats), over 52 weeks. Approximately two third of the data set (640 households) is used for model estimation, one third for model validation (266 households).

Dependent variable: shopping patterns/ store set identification

As indicated above, the dependent variable in our model represents the household's stable selection of a shopping pattern (I single, II separate, or III combined) and - within each pattern - choice of a specific store (pattern I) or set of stores (pattern II and III). To operationalize this variable, we proceed as follows. First, as even the 'hard core loyal' consumers do occasionally patronize stores other than their primary chain, we characterize consumers as single store shoppers if they spend more than 80% of their shopping baskets at one and the same store. Consumers that do not meet that cut-off are classified as multiple store shoppers. Second, of these multiple store shoppers, consumers for whom the majority of store visits occur on combined trips (visits to more than one store on the same part of the day; see Fox & Hoch, 2005) are identified as combined-store shoppers. The remaining households are typified as separate-store shoppers.

Explanatory variables: Cost components

Variable Costs. To incorporate net variable shopping costs, we distinguish between three main types of product categories: convenience, specialty, and fresh products (see also Fader & Lodish 1990 and Dhar et al. 2001). These categories mainly differ in perishability (low for specialty and convenience, high for fresh, Krider & Weinberg 2000) and perceived quality differentiation within the category (low for convenience items, high for specialties and fresh, Corstjens & Corstjens, 2000; Fernández-Barcala & González-Diaz, 2006). Also, demand for specialty items is typically lower than for fresh and convenience categories (Sprott, Manning & Miyazaki, 2003; Dhar, Hoch & Kumar, 2001).

<insert Table 4>

The products in our data set were classified into these 'generic' product category types by two independent experts, yielding high inter-expert reliability. Examples of products in each category type are: canned food (convenience categories), health and beauty care (specialties) and fish/meat (fresh categories). For each product category type, a household's *demand* (D_p^h) is computed on a monthly basis and, to allow for meaningful aggregation across products, expressed in monetary units (at the product's average market price). Next, to obtain an estimate of store-specific *variable costs and benefits*, this demand variable is multiplied with the store's price index (PI_{p,s_i}) and variable benefit index for the product (VBI_{p,s_i}), resp. Given our purpose to explain stable shopping patterns, we include 'average' store characteristics over the observation period as explanatory variables in the model. The variable benefit index reflects both intrinsic quality and assortment, and is obtained as $VBI_{p,s_i} = QI_{p,s_i} * (Size_{s_i})^k$, where QI_{p,s_i} is an indicator of the average quality of product p in store s_i (obtained from surveys among store shoppers; Testaankoop, 2000), $Size_{s_i}$ is a measure of store format surface (see González-Benito et al., 2007, for a similar approach), and κ is a parameter (capturing the effect of assortment size on perceived variable benefits; Oppewal & Koelemeijer, 2005).

Holding costs. Like Krider and Weinberg (2000) and Bhatnagar and Ratchford (2004), we assume holding costs to be similar for convenience and specialty products, and lower than those of fresh goods. For lack of reliable storage cost measures, we treat both the base level (σ, representing the cost of keeping one unit in store for one month) and the differences between products (the storage cost index SI_p, set to one for convenience and specialty products, and estimated for fresh products) as 'parameters' in the model.

Fixed costs. Previous research has demonstrated that in-store benefits and costs are strongly related to type of store format (see e.g. Bhatnagar & Ratchford, 2004). In-store search and waiting costs are typically higher for larger stores (such as hypermarkets), while in-store benefits tend to be lower for discount stores (which usually economize on store layout and customer service in order to keep product prices down). Based on these two dimensions – store size and price/quality position - four stylized types of grocery store formats can be distinguished (Kahn & McAlister, 1997; Sinha, 2000; Popkowski-Leszczyc, Sinha & Timmermans, 2000; González-Benito, 2004): (i) small & quality-oriented *supermarkets*, (ii) large & quality-oriented *superstores*, (iii) small & price-oriented *hard discounters*, and (iv) large & price-oriented *large discounters*. To capture the resulting differences in net fixed shopping costs between these store formats, we incorporate parameters δ_f into the model, reflecting the in-store costs minus benefits for each store format f (the dummies F_{f,s_i} indicate whether store s_i belongs to format f, where f refers to supermarket SM, superstore SS, hard discounter HD, or large discounter LD). For combined shopping trips, we specify the total in-store shopping cost as a fraction ν of the sum of in-store shopping costs for the two store visits. In the analysis below, we set ν equal to ¾, which is half way between the two extremes of adding or averaging the in-store costs across stores. Sensitivity analysis reveals that the estimated parameters are rather insensitive to the specific level of ν. In addition, to account for transportation costs associated with the trip to and from the store, we include the distance ($Dist_{s_i}^h$) between a household's residence and the store s_i (or, in case of combined trips: the distance $Dist_{s_i,s_j}^h$ for half a round trip including stores s_i and s_j). Plugging these cost components into the optimal cost expressions derived in into the optimal cost expressions derived in Table 2, the total costs for the single pattern (I), separate pattern (II) and combined pattern (III) in equations (2a), (2b) and (2c) take the following form:

$$TC^h_{I,s_i} = \sqrt{2(\sum_f \delta_f F_{f,s_i} + \beta Dist^h_{s_i})(\sum_p \sigma SI_p D^h_p)} + \sum_p D^h_p PI_{p,s_i} - \gamma \sum_p D^h_p VBI_{p,s_i} \tag{3a}$$

$$TC^h_{II,(s_i,s_j)} = \sum_{s=s_i,s_j} \Big(\sqrt{2(\sum_f \delta_f F_{f,s} + \beta Dist^h_s)(\sum_p \sigma SI_p D^h_p (\alpha^{II,h}_{p,s})^2)} + \sum_p D^h_p PI_{p,s}(\alpha^{II,h}_{p,s}) - \gamma \sum_p D^h_p \, VBI_{p,s}(\alpha^{II.h}_{p,s}) \tag{3b}$$

$$TC^h_{III,(s_i,s_j)} = \sqrt{2((\sum_f \delta_f F_{f,s_i} + \sum_f \delta_f F_{f,s_j})\nu + \beta Dist^h_{s_i,s_j})(\sum_p \sigma SI_p D^h_p)} + \sum_{s=s_i,s_j}\left[\sum_p D^h_p PI_{p,s}\alpha^{III,h}_{p,s} - \gamma \sum_p D^h_p VBI_{p,s}\alpha^{III,h}_{p,s}\right] \tag{3c}$$

The variables and their operationalizations are summarized in Table 4, and the parameters to be estimated relate to storage cost (σ and $SI_{p=fresh}$), the impact of distance on fixed shopping cost (β), fixed in-store shopping cost minus benefits by format (δ_f for *f=SM, SS, HD and LD)*, the weight attached to variable benefits (as opposed to purchase price, γ), and the coefficient measuring the impact of assortment size on variable store benefits (parameter κ , see also Table 4). Being derived from the households' cost minimization problem, equations (3a)-(3c) quantify the minimum cost levels per shopping pattern/store set alternative, with underlying store visit frequencies and category purchase allocations as given in Table 2.

4.2. Model estimation.

Parameter estimates are obtained by maximizing the following loglikelihood function:

$$LL = \sum_h \left[\sum_{s_i} y^h_{I,s_i} \ln(P^h_{I,s_i}) + \sum_{(s_i,s_j)} y^h_{II,(s_i,s_j)} \ln(P^h_{II,(s_i,s_j)}) + \sum_{(s_i,s_j)} y^h_{III,(s_i,s_j)} \ln(P^h_{III,(s_i,s_j)}) \right] \tag{4}$$

where y^h_{I,s_i} , $y^h_{II,(s_i,s_j)}$ and $y^h_{III,(s_i,s_j)}$ indicate whether the household exhibited a single pattern (I) to store s_i, a separate-store pattern (II) to s_i and s_j, or a combined-store pattern (III) to s_i and s_j, resp.

As can be seen from expressions (3a)-(3c), the base level of holding costs σ on the one hand, and the parameters driving fixed shopping cost β and δ_f for f= *SM, SS, HD and LD;* on the other hand, are identified up to a scale factor only. We therefore set σ equal to one and estimate the levels of β and δ_f relative to this value of σ. In a later stage, additional data on the households' number of shopping trips are used to separate out the holding costs from the fixed shopping costs.

For multiple store shopping patterns, the fraction of a product's demand fulfilled in a store s_i (α^h_{II,p,s_i} and α^h_{III,p,s_i}) are themselves a complex function of the remaining model parameters (see Table 2). Model estimation is, therefore, carried out in two steps. In a first step, we set the level of α^h_{II,p,s_i} and α^h_{III,p,s_i} equal to .5, and obtain preliminary estimates for the model parameters. Based on these initial parameter values, we then calculate updated values for α^h_{II,p,s_i} and α^h_{III,p,s_i} (Because for separate shopping trips where we do not have closed form expressions for optimal trip frequencies and category allocations, this updating requires an iterative procedure). In a second step, these new α^h_{II,p,s_i} and α^h_{III,p,s_i} are fed into equations (3b) and (3c), to obtain our final estimates (additional iterations did not entail further parameter changes).

Given that we have only one observation (stable shopping pattern) per household, mixed-logit estimation does not provide very reliable estimates for across-household variances (see Bhat, 2000; Small, Winston & Yan, 2003; and Leenheer, van Heerde, Bijmolt & Smidts, 2007 for a similar observation). Yet, the mean estimates of the mixed-logit model are comparable to those of the model without heterogeneity. Moreover, as discussed in more detail below, validation checks based on holdout sample data indicate that the accuracy of predicted shopping outcomes is quite similar for the estimation and the holdout sample – supporting the validity of our findings across households.

4.3. Results: Descriptives

Multiple Store Shopping. Our data confirm that many consumers visit multiple stores on a regular basis. Using the classification rules explained above, we find that 61.9% of the customers consists of multiple store shoppers. Most of these customers usually visit both stores on separate shopping trips (90.8%), a much smaller group visits the different stores on the same shopping trip (9.2%). These shopping patterns also appear to be quite stable over time. To check this, the one-year data set was split in half, and dominant shopping patterns were determined for and compared between these two periods. Overall, the large majority of consumers (83%) appears to hold on to the same shopping pattern. In addition, although there are some small differences, ‘stay rates’ appear to be quite high for each of the shopping patterns (single store shopping 85%, separate MSS 83%, combined MSS 75%).

Store characteristics. Table 5 reports, for each of the 12 chains, their format, and price and quality indices by category type. Our data cover a wide range of store formats: five supermarkets, two superstores, two hard discounters and three large discounters. As expected, these formats exhibit clear price/quality differences between the product categories (Corstjens & Corstjens 2000): while discounters focus more on convenience products - for which they offer relatively high quality products at much lower prices - supermarkets and superstores differentiate themselves by offering a higher quality assortment of fresh and specialty products.

<insert Table 5>

Store formats and MSS shopping patterns. Figure 3 reports the market shares of the different formats among single store shoppers, as well as among separate-trip and combined-trip MSS shoppers. Market shares of supermarkets and large discounters are quite similar for each of the three shopping patterns. Superstores, in contrast, appear to attract a much higher share of grocery spending from single compared to multiple store shoppers. The opposite pattern is observed for hard discounters, which – while unsuccessful among single store shoppers - capture a substantially higher share of expenditures from customers who visit multiple stores on separate, and especially on combined, shopping trips.

Table 6 sheds further light on store formats’ co-occurrence in MSS patterns. For each type of store format (row), the table reports the percentage of cases in which this format is combined with stores of the same or different format, in separate (panel a) or combined (panel b) MSS patterns. For instance, row 1 indicates that of separate-store MSS shoppers who visit a supermarket, 18% visit another supermarket, 17% a superstore, 32% a hard discounter and 33% a large discounter as their ‘other’ store. Although these figures do not account for the effect of store distance and household category demand, they already reveal some interesting patterns – suggesting that MSS is more prominent among stores with different fixed (size/store service and atmosphere) or variable (price/quality of product assortments) shopping costs. Typical examples are the high percentage of HD – SM combinations, and the extremely low percentages of combinations of same-format stores.

<insert Table 6, Figure 3>

4.4. Results: Estimation Outcomes

Model fit

To assess how well the model fits the observed purchase patterns (i.e., shopping pattern type and selected store or store set), we compare it with two benchmark models. A first null model, M0, predicts the choice probability of a store set based on the individual stores' share of visits in the market (a single store pattern is 'reconstructed' as a set with twice the same store). A second benchmark model, M1, specifies the utility for a store set as the average utility of each of the two stores, the latter being (minus) the total shopping cost of a single store shopping pattern. This second benchmark takes distance and store characteristics into account, but does not recognize store complementarity (e.g. the possibility of avoiding fixed shopping costs by combining closely located stores, or reducing variable shopping costs by selectively purchasing different categories in different stores). The multiple store shopping model MSS (given by (2a)-(2c) and (3a)-(3c)) yields a significantly better fit to observed shopping pattern/store set choices in the estimation sample: its loglikelihood being significantly higher than that of both benchmarks (M0: LL= -2392.1, M1: LL= -2138.5, MSS: LL= -2102.7) and its BIC lower (M0: BIC=4822.8, M1: BIC=4299.6, MSS: BIC=4226.6). The MSS model also outperforms both benchmarks in the holdout sample (M0: LL=-1008.9, M1: LL=-878.0, MSS: LL=-870.0) – although its advantage over model M1 is quite small.

Parameter estimates.

Table 7 summarizes the estimation results. As expected, distance significantly increases *fixed shopping cost* (β=.328, p<.01). In addition, fixed in-store costs (net of benefits) are substantially higher for hard and large and discounters than for supermarkets and superstores (δ_{HD}=1.206, p<.01; δ_{LD}=1.698, p<.01,). This suggests that households' perceptions of fixed in-store costs are not primarily driven by time costs induced by store size, but are also strongly attenuated by ambience attributes like store atmosphere, cleanliness and friendliness - attributes on which superstores and supermarkets score high.

<insert Table 7>

Storage cost of fresh products appears to be between two and three times that of other product types (SI_{fresh}=2.401, p<.10), a figure that makes intuitive sense. The results further confirm that *variable shopping costs* depend on product prices as well as quality differences (γ=1.307, p<.05), where - as expected - more varied assortments appear to provide substantially higher variable shopping benefits (significant and positive impact of assortment size: κ=.095, p<.05). Table 8 reports the net unit variable cost weighted (divided) by holding cost for each category and chain. The bottom rows of the table indicate correlations between these variable costs and the stores' price and quality descriptors (reported in Table 5): as expected, differences in variable costs for convenience items are predominantly driven by price, while those for specialty items are mainly shaped by quality ratings with fresh products in-between the two.

Using the definitions in Table 3, these variable cost estimates allow to assess *category preference complementarity* and *category preference asymmetry* relationships for each pair of stores. Category preference complementarity predominantly prevails for the combination hard discounter – supermarket. For 7 out of the 10 combinations, the hard discounter has a clear advantage for convenience products, while supermarkets score better on the other categories. For instance, in Table 8, Aldi and Champion, appear to be category preference complements, as Aldi has lower weighted variable costs than Champion for convenience products (Aldi: -.273 < Champion:-.202), and higher levels for the other products (for specialties: Aldi: -.121 > Champion: -.278, for fresh: Aldi: -.026 > Champion: -.060), consistent with the results in Table 6 where hard discounters and supermarkets constituted the most frequently occurring format combinations.

Large discounters, as expected, exhibit the lowest net variable costs for all categories: they manage to keep their prices low, while at the same time offering an appealing product assortment. As a result, these large discounters mostly exhibit category preference asymmetries - not complementarities - with other formats. In Table 8, for instance, such asymmetries are observed between large discounter Colruyt and supermarket DelhaizeDL, where Colruyt has lower weighted variable costs in each category type, but its advantage is less pronounced for fresh products.

The position of the two superstores is somewhat less clear, category preferences being complementary for some store combinations and only asymmetric for others. A possible explanation is that these stores are gradually moving to the position of large discounters: while maintaining a large assortment, both superstores have tried to counter the price competition from discounters by heavily investing in private label products and by reducing their overall price level (now explicitly positioning themselves as EDLP-stores)[5].

Finally, some store pairs (mostly within the same format) exhibit neither complementarity nor clear asymmetry. An example in Table 8 would be supermarkets GBSuperPartner and DelhaizeDL, for which the difference in weighted variable cost is quite similar in each category.

<insert Table 8>

4.5. Model Validation

While the model appears to fit the data well – and better than two traditional benchmark models – we performed four additional validity checks to test the appropriateness of the dependent variable measure and the realism of the underlying behavioral assumptions (store combinations, optimal store visit frequencies and product category allocations).

First, we conducted a robustness check using an alternative operationalization of the dependent variable. We (i) divided the total observation period in a sequence of 4-week observations, (ii) assessed the consumers' shopping pattern in each of those periods, and (iii) re-estimated the model using as the dependent variable the fraction of times a consumer exhibits a single, separate or combined store shopping pattern. The resulting coefficients are highly similar to those reported in Table 7, supporting the robustness of the outcomes and providing additional indications on the stability of shopping patterns.

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[5] While this seems to be a very plausible explanation, we cannot exclude though that there is still some complementarity in category preference between both store formats at subcategory levels. Given that we distinguish only three – very broad - product types, our model may miss out on specific category complementarities through aggregation.

Second, we compared the *observed* frequency of occurrence of complementary store sets in combined and separate multiple store shopping patterns on the one hand, with their *expected* co-occurrence based on chance (using the stores' overall visit shares as priors) on the other. The results confirm that combinations of complementary stores occur much more frequently than would be expected by chance ($p<.01$ for both separate visit and combined shopping patterns).

Third, we compared the store visit share predictions implied by our MSS model (based on the model estimation results and the optimal store visit expressions included in the second column of Table 2), with those of a benchmark specification. As a benchmark, we use a 'traditional' multinomial logit model, in which we predict the households' store choice probability based on individual trip data - using similar explanatory variables as in the multiple store shopping model and, like in the MSS model, including the seven closest chains into a household's consideration set (see online appendix for details). The multiple store model (with MAD=.085 in the estimation sample, and MAD=.087 in the holdout sample) predicts actual store visit shares better than this benchmark (with MAD =.088 and MAD=.091 in the estimation and the holdout sample, resp.) – a fairly strong result, as the latter model intends to approximate actual store choice probabilities directly.

Finally, like for store visit shares, we check to what extent *expected category purchase allocations* implied by the MSS model (based on the model estimation results and optimal allocation expressions in column 3 of Table 2) match observed allocations. In each category, we adopt as a benchmark model the Tobit-2 share-of-wallet model recently presented by Leenheer et al. (2007). This model can accommodate dependent variables that constitute shares (i.e. sum to one for each household across stores) yet may take on zero values (in case nothing is spent in a particular store). It also allows one to specify the category spending shares of stores *directly* (in this case, without including store visit decisions) as a function of store- and category characteristics (i.e. distance, store format constants, price and variable benefit indices, see online appendix for details). We compare the fit of this Tobit-2 benchmark model estimated by product category, with that of our proposed model. Like before, we find that the multiple store shopping model performs better; its mean absolute deviation between actual and predicted store spending shares in the estimation sample (MAD convenience products: .099, MAD specialties: .100, MAD fresh products: .105) being lower than that of the benchmark specification (MAD convenience products: .107, MAD specialties: .105, MAD fresh products: .109) in each category. Similar results occur in the holdout sample, with deviations for the MSS model of MAD= .098 for convenience products, MAD=.099 for specialties and MAD=.105 for fresh products compared to the benchmark specification results of MAD convenience products: .107, MAD specialties: .106 and MAD fresh products: .109.

5. Discussion

In line with previous literature, we find that the majority of consumers regularly visits more than one store for grocery purchases, and that sales promotions alone do not explain why consumers engage in multiple-store shopping, as many store 'switches' appear to be a regular sequence of multiple store visits. To our knowledge, this paper is the first to provide a comprehensive and formal analysis of why and how customers divide their grocery purchases over different stores on a systematic basis. By considering (i) shopping benefits as well as costs, (ii) store choice as well as shopping pattern decisions, and (iii) overall as well as category-specific store features, we provide a more complete account of systematic multiple store shopping motivations and shopping patterns.

Motives for systematic (non-promotion based) multiple store shopping. Our research reveals that - even in the absence of promotions - consumers may have good reasons for shopping multiple grocery stores. In particular, we find that grocery outlets may only become part of a multiple store strategy if they exhibit fixed cost or category preference complementarity.

First, patronizing stores with *different fixed shopping costs* may be an appealing compromise strategy between exclusively shopping in either of these stores. This is true even if one store offers better value for all categories, provided that (i) there is category preference asymmetry –the degree of store preference differs across categories and (ii) there is a 'total cost conflict'- the high unit variable cost store has a lower fixed cost per visit. We refer to this case as 'fixed cost complementarity'. By purchasing the more strongly preferred categories primarily in the high fixed cost store, but making in-between visits for the other categories to the low fixed cost store, the consumer may achieve the 'best of both worlds'.

Second, we show that multiple store shopping may also be triggered by *category preference complementarity* - each store being preferred for at least one of the product categories. By systematically buying products in the store where they are most attractive, consumers can minimize their total variable shopping costs.

MSS trip organization. Our research establishes a link between these motives and the way shopping trips are organized. With fixed cost-complementarity, stores are always visited on separate shopping trips. With category preference complementarity, consumers may also engage in combined shopping trips, and the choice between separate versus combined store visits presents an interesting trade off between fixed and variable shopping costs. On the one hand, combined visits allow the consumer to save on transportation costs per trip and purchase each product exclusively in the store where it is preferred. When the stores are visited on separate trips, however, the number of trips per store can differ, and trips to different stores can be spread in time. This allows the consumer to purchase high holding cost categories on a more frequent basis, shifting some portion of these categories' purchases to the less preferred store.

Patterns of Competition between grocery stores. Empirical results obtained from a scanner panel data set support the descriptive validity of our shopping cost model and its implied complementarities, which appear to be linked to store format. In particular, our empirical results suggest that fixed cost complementarity is more likely to occur between large discounters (with high in-store fixed costs but low unit variable costs) on the one hand and supermarkets or hard discounters (with lower in-store fixed costs but (somewhat) higher variable costs) on the other. For these store pairs, separate visit-multiple store shopping - where major trips alternate with fill-in trips to replenish high storage cost categories- is likely to occur. At the same time, we find evidence of category preference complementarity, especially between hard discounters and supermarkets. This may encourage consumers to selectively buy different categories in these different stores, either on separate or combined trips.

These results have important implications for store competition. Depending on their store's characteristics compared with local competitors, a retailer may find it more appropriate to pursue complete loyalty among a subset of consumers (share-of-customer competition), or – in the presence of complementary stores – try to maximize share in categories where they are relatively strong based on fixed or variable cost position ('share-of-wallet' competition). In the latter case, an interesting insight from our model is that inter-store distances play an entirely different role depending on the type of store complementarity. With fixed-cost complementarity, low-fixed cost stores typically derive their relative appeal from being 'closer' to the customer than their competitor, and hence experience near-by competition as a serious threat. This would, for instance, be the case for a supermarket faced with the entry of a large discounter in its local market. When stores are category-preference complements, such as a supermarket and a hard discounter, location close to the complementarity store may actually have the opposite impact. By facilitating combined store visits, it may create an 'attraction' effect and even benefit chains, allowing them to 'team up' against more remote competitors that have an appealing offer across-the-board.

6. Limitations and Future Research.

Clearly, this research exhibits limitations, and leaves ample opportunities for future research. First, our formal model is stylised, focusing on multiple store shopping patterns involving two stores. Even though our MSS model appears to fit the data well, analysing patterns including three or more stores may be an interesting research avenue.

Second, the stores considered are food-oriented retail outlets, essentially carrying the same assortment. Considering a broader set of retail formats may add to the complexity of the shopping decision process – which may become single as well as multiple purpose – yielding additional insights into multiple store shopping motivations.

Third, our shopping model describes consumers as fully informed, rational decision makers, with fixed category demand and able to perfectly plan their consumption ahead. Interesting extensions of our model would be to include the possibility of category consumption expansion, impulse purchases, and urgent/unplanned trips. These will add to the realism of our model, and may uncover additional motives for multiple store shopping.

Fourth, given our focus on *systematic* multiple store shopping, we consider a 'stable' setting, leaving out the impact of temporary promotions. This allows us to isolate non-promotional motives triggering multiple store shopping. Adding the effect of promotional strategies to our equilibrium model will lead to an even richer representation of consumer shopping behavior, indicating how opportunistic - promotion-based - store switching interacts with MSS. Fifth, like most previous store choice papers, we use simple cost specifications. Introducing thresholds/nonlinearities like storage space constraints, the purchase of discrete package sizes, and time-dependent transaction costs would be a fruitful extension of our model. Finally, while the main focus in this paper is on optimal shopping patterns from the consumer's viewpoint, an important next step will be the development of normative retailer models accommodating consumers' MSS behavior.

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Table 1: Overview of recent store choice (modeling) literature

Article	Decision variable/ level of choice decision			Additional shopping decisions		Shopping purpose[a]	Decision context[b]/ Plan.horizon[c]	Data
	Store (choice)	Store format	St.location/ destination	Store visit frequency/timing	Expenditures /Purchase Incidence			
Panel (a): Short-term store choice decisions								
Bell & Lattin(1998)	X	x			x	SP	Trip/ST	Panel data
Bell et al. (1998)	X					SP	Trip/ST	Panel data
Popkowski Leszczyc et al. (2000)	X			x		SP	Trip/ST	Panel data
Sinha (2000)	X		x			SP	Trip/ST	Survey Data
Fox & Semple (2002)	x					SP	Trip/ST	Panel data
Gonzaléz-Benito (2002)	X					SP	Trip/ST	Panel data
Rhee & Bell (2002)	X					SP	Trip/ST	Panel data
Solgaard & Hansen (2003)		x				SP	Month/MT	Survey Data
Fox et al. (2004)		x			x	SP	Month/MT	Panel data
Popkowski Leszczyc et al. (2004)	X					MP	Month/MT	Survey Data
Suárez et al. (2004)	X		x			SP	Trip/ST	Survey Data
Arentze et al. (2005)			x			MP	Trip/ST	Survey Data
Gonzaléz-Benito (2005)		x				SP	Trimester/MT	Panel data
Briesch et al. (2006)	X					SP	Trip/ST	Panel data
González-Benito et al. (2007)	X	x				SP	Month/MT	Survey Data
Panel (b): Long-term strategic store choice decisions								
Ghosh & McLafferty (1984)			x	x		MP	Strat./LT	Simulation
Ingene & Ghosh (1990)			x	x		MP	Strat./LT	Simulation
Messinger & Narasimhan (1997)		x				SP	Strat./LT	Sales data
Dellaert et al. (1998)			x			MP	Strat./LT	Experiment
Galata et al.(1999)	X	x				SP	Seg's/LT	Panel data
Krider & Weinberg (2000)	X			x	x	SP	Strat./LT	Survey Data
Popkowski L.& Timmermans (2001)		x				MP	Strat/LT	Experiment
Drèze & Vanhuele (2006)	X	x				SP	Seg./LT	Panel data

[a] SP = single purpose, MP = multiple purpose

[b] Trip = store choice decision is made per shopping trip (note that Fox and Semple 2002 only take cherry picking trips into account), Month/trimester = shopping decisions within one month/trimester, Strat = strategic (i.e. optimal LT) shopping decisions, Seg = stable differences in shopping behavior between customer segments

[c] ST = short term, MT = medium term, LT = long term

Table 2: Minimum Total Cost and Optimal decisions

Pattern	Number of Trips	Category Allocation[a]	Minimum Total Cost
Single Store (I)	$N_{s1} = \sqrt{(S_{p1}D_{p1} + S_{p2}D_{p2})/2t_{s1}}$	$\alpha_{I,p2,s1} = 1 \quad \alpha_{I,p1,s1} = 1$	$TC^{*}_{I,s1*} = \sqrt{2t_{s1}(S_{p1}D_{p1} + S_{p2}D_{p2})}$ $+ D_{p1}VC_{p1,s1} + D_{p2}VC_{p2,s1}$
Separate Stores (II), stores s1 and s2	$N_{s1} = \sqrt{(S_{p1}D_{p1}\alpha^{2}_{II,p1,s1} + S_{p2}D_{p2}\alpha^{2}_{II,p2,s1})/2t_{s1}}$ $N_{s2} = \sqrt{\dfrac{(S_{p1}D_{p1}(1-\alpha_{II,p1,s1})^{2} + S_{p2}D_{p2}(1-\alpha_{II,p2,s1})^{2})}{2t_{s2}}}$	$\alpha_{II,p1,s1} = 1 \; if \; I_{p1,s1-s2} > 1/N_{s1}$ $\alpha_{II,p1,s1} = 0 \; if \; I_{p1,s1-s2} < -1/N_{s2}$ $\alpha_{II,p1,s1} = \dfrac{I_{p1,s1-s2} + 1/N_{s2}}{1/N_{s1} + 1/N_{s2}}$ *otherwise*	$TC^{*}_{II,s1-s2} = \sqrt{2t_{s1}(S_{p1}D_{p1}\alpha^{2}_{II,p1,s1} + S_{p2}D_{p2}\alpha^{2}_{II,p2,s1})} +$ $\sqrt{2t_{s2}(S_{p1}D_{p1}(1-\alpha_{II,p1,s1})^{2} + S_{p2}D_{p2}(1-\alpha_{II,p2,s1})^{2})} +$ $D_{p1}(VC_{p1,s1}\alpha_{II,p1,s1} + VC_{p1,s2}(1-\alpha_{II,p1,s1}))$ $+ D_{p2}(VC_{p2,s1}\alpha_{II,p2,s1} + VC_{p2,s2}(1-\alpha_{II,p2,s1}))$
Combined Stores (III)	$N_{s1s2} = \sqrt{(S_{p1}D_{p1} + S_{p2}D_{p2})/2t_{s1s2}}$	$\alpha_{III,p1,s1} = 1$ if $I_{p1,s1-s2} > 0$, and $\alpha_{III,p1,s1} = 0$ otherwise. $\alpha_{III,p2,s1} = 1$ if $I_{p2,s1-s2} > 0$, and $\alpha_{III,p2,s1} = 0$ otherwise.	$TC^{*}_{III,s1-s2} = \sqrt{2t_{s1s2}(S_{p1}D_{p1} + S_{p2}D_{p2})}$ $+ D_{p1}(\alpha_{III,p1,s1}VC_{p1,s1} + (1-\alpha_{III,p1,s1})VC_{p1,s2})$ $+ D_{p2}(\alpha_{III,p2,s1}VC_{p2,s1} + (1-\alpha_{III,p2,s1})VC_{p2,s2})$

[a] As indicated in Table 3, $I_{p1,s1-s2}$ represents the difference in the stores' variable cost relative to holding for product p1, or : $I_{p1,s1-s2} = \dfrac{(VC_{p1,s2} - VC_{p1,s1})}{S_{p1}}$

Table 3: Glossary of key terms linked to MSS Motivations

Term	Description	Specification
Category-specific store preference (for product p1 in store s1 compared to store s2)	The difference between product p1's unit variable cost, weighted (divided) by its unit holding cost, in store s2 and store s1	$I_{p1,s1-s2} = \frac{(VC_{p1,s2} - VC_{p1,s1})}{S_{p1}}$ If greater than 0, store s1 is preferred over store s2 for product p1
Uniform category preferences	Based on variable costs divided by holding costs, one store may be preferred over the other for both categories, but the difference in store preference is the same for all categories	$I_{p1,s1-s2} = I_{p2,s1-s2}$
Category preference asymmetry	Based on variable costs divided by holding costs, one store is preferred over the other for both categories, but the difference in store preference is greater for one category than for the other	$I_{p1,s1-s2} . I_{p2,s1-s2} > 0$ *and* $I_{p1,s1-s2} \neq I_{p2,s1-s2}$
Category preference complementarity	Based on variable costs divided by holding costs, one store is preferred over the other for one category, but the other store is preferred for the second category	$I_{p1,s1-s2} . I_{p2,s1-s2} < 0$
Total cost conflict	One store offers the lowest fixed costs, the other store the lowest variable costs.	$t_{s1} > t_{s2}$ $\Sigma_p D_p VC_{p,s1} < \Sigma_p D_p VC_{p,s2}$

Table 4: Overview of model variables[a]

Variable[b]	Description	Operationalization
Dependent variable		
$y^h_{sp,s}$	Dependent variable, indicating the households dominant shopping pattern and stable choice of store or set of stores	Dummy equal to 1 if household h selected shopping pattern sp and store (set) s, and equal to 0 elsewhere. *sp* is equal to I if the household opted for a single store shopping pattern, II for separate MSS patterns, and III for combined MSS patterns. *s* is an index indicating the selected store (shopping pattern I), or set of stores (shopping pattern II and III).
Demand		
D^h_p	Category demand	Household's demand for the category, computed on a monthly basis and, to allow for meaningful aggregation across products, expressed in monetary units (at the product's average price across stores)
Variable benefits and costs		
VC_{p,s_i}	Unit (net) variable shopping cost	Net variable cost per unit of category p in store s_i. $VC_{p,s_i} = PI_{p,s_i} - \gamma VBI_{p,s_i}$ where γ is a parameter to be estimated
PI_{p,s_i}	Price index	Price index for product p in store s_i, obtained as the store 's own unit price for the product, relative to the average product unit price across stores, based on consumer surveys and observed product prices
VBI_{p,s_i}	Variable benefit index	Index for 'variable benefits' per unit (100 Euro) spent on product p in store s_i , obtained as $VBI_{p,s_i} = QI_{p,s_i} * (Size_{s_i})^{\kappa}$ where κ is a parameter to be estimated
QI_{p,s_i}	Assortment quality	Quality index for category p in store s_i obtained from consumer surveys
$Size_{s_i}$	Assortment size	Approximated by typical store format surface (in 2500 m^2), assuming that larger stores provide a more varied assortment for most product categories.
Storage costs		
S_p	Storage cost per unit	Absolute storage cost per unit for category p over a one month period, obtained as $S_p = \sigma * SI_p$ where parameter σ represents the (separately estimated) base level.
SI_p	Storage cost index	Category-specific storage cost index, set to one for convenience and specialty products, and estimated for fresh products.
Fixed shopping benefits and costs		
$t^h_{s_i}$	Fixed shopping cost per trip	Net fixed cost incurred per trip to store s_i for household h: $t^h_{s_i} = F_{f,s_i} + \beta\, Dist^h_{s_i}$ where β is a parameter to be estimated
F_{f,s_i}	Store format indicator	Dummy equal to one if store s_i belongs to format f (Hard discounter, Large discounter, Superstore, Supermarket) and zero elsewhere.
$Dist^h_{s_i}$	Store distance	Distance in kilometres between household h's residence and store s_i (or, in case of combined trips: the distance $Dist^h_{s_i,s_j}$ for half a round trip including stores s_i and s_j).

[a] p = product indicator. Product categories are classified as either convenience, (p=1), specialties (p=2) or fresh products (p=3).

[b] Left-aligned variables correspond to cost components in the general minimum cost expressions in the last column of Table 2. Right-aligned variables below them correspond to underlying measures in the empirical cost functions (3a)-(3c).

Table 5: Store descriptives: price index (*$PI_{p,s}$*) and quality index (*$QI_{p,s}$*) by product category

Chain	Format	Convenience		Specialties		Fresh	
		price	quality	price	quality	price	quality
Aldi	Hard discounter	0.81	0.98	0.91	0.94	0.88	0.86
Champion	Supermarket	0.99	1.00	0.95	1.02	1.13	1.06
Colruyt	Large discounter	0.80	1.00	0.90	1.05	0.85	1.03
Cora	Superstore	0.98	1.04	1.08	1.03	0.90	1.02
DelhaizeAD	Supermarket	1.08	1.01	1.02	1.03	1.06	1.02
DelhaizeDL	Supermarket	1.07	1.01	1.12	1.02	1.05	1.03
GBMaxi	Superstore	1.08	0.97	1.19	0.93	1.08	0.99
GBSuper	Supermarket	0.98	0.99	1.03	0.97	1.18	0.98
GBSuperpartner	Supermarket	1.04	0.99	1.09	0.99	1.00	1.00
Intermarché	Large discounter	0.85	0.99	0.97	1.00	0.99	1.00
Lidl	Hard discounter	0.85	0.98	0.90	0.95	0.86	0.94
Makro	Large discounter	0.92	1.03	1.05	1.04	0.85	1.03

Table 6: Stores co-occurring in MSS patterns[a]

	SM	SS	HD	LD
Panel (a): Separate Store Shopping				
SM	0.18[b]	0.17	0.32	0.33
SS	0.46	0.004	0.28	0.26
HD	0.51	0.17	0.01	0.31
LD	0.51	0.15	0.30	0.04
Panel (b): Combined Store Shopping				
SM	0.06	0.09	0.63	0.23
SS	0.33	0.00	0.33	0.33
HD	0.62	0.09	0.06	0.23
LD	0.40	0.15	0.40	0.05

[a] SM = supermarket, SS = superstore, HD = hard discounter, LD = Large discounter

[b] Table entries should be read as follows: of all households visiting a supermarket in a separate visit multiple store shopping pattern (row: Separate store shopping - SM), 18% visits another supermarket (column SM), 17% a superstore (column SS), 32% a hard discounter (column HD) and 33% a large discounter (column LD) as their other store.

Table 7. Estimation Results for the Multiple Store Shopping (MSS) Model

Parameter	**Variable**	**Mean**	**SD**
Variable costs and storage costs			
γ	Quality	1.307	.620
κ	Assortment Size	.095	.048
SI_{fresh}	Holding Cost Index Fresh	2.401	1.53
Fixed shopping costs			
β	Distance	.328	.114
δ_{HD}	Hard Discounter	1.206	.350
δ_{LD}	Large Discounter	1.698	.692
δ_{SS}	Superstore	-.006	.031

Table 8: Weighted variable cost estimates by category type for different chains

Chain	Format	Product Category		
		Convenience	**Specialties**	**Fresh**
Net Unit Variable Cost weighted (divided) by Holding Cost, estimated as $(PI_{p,s} - \gamma VBI_{p,s})/SI_p$				
Aldi	Hard discounter	-.273	-.121	-.026
Champion	Supermarket	-.202	-.278	-.060
Colruyt	Large discounter	-.515	-.471	-.206
Cora	Superstore	-.384	-.274	-.179
DelhaizeAD	Supermarket	-.136	-.217	-.071
DelhaizeDL	Supermarket	-.140	-.114	-.079
GBMaxi	Superstore	-.192	-.031	-.090
GBSuper	Supermarket	-.209	-.134	-.001
GBSuperpartner	Supermarket	-.143	-.105	-.081
Intermarché	Large discounter	-.452	-.339	-.132
Lidl	Hard discounter	-.229	-.144	-.074
Makro	Large discounter	-.439	-.314	-.209
Correlation with chain price and quality index[a]				
Price index		.71	.50	.63
Quality index		-.40	-.76	-.47

[a] Price and Quality indices included in Table 5

Figure 1: Conceptual Framework

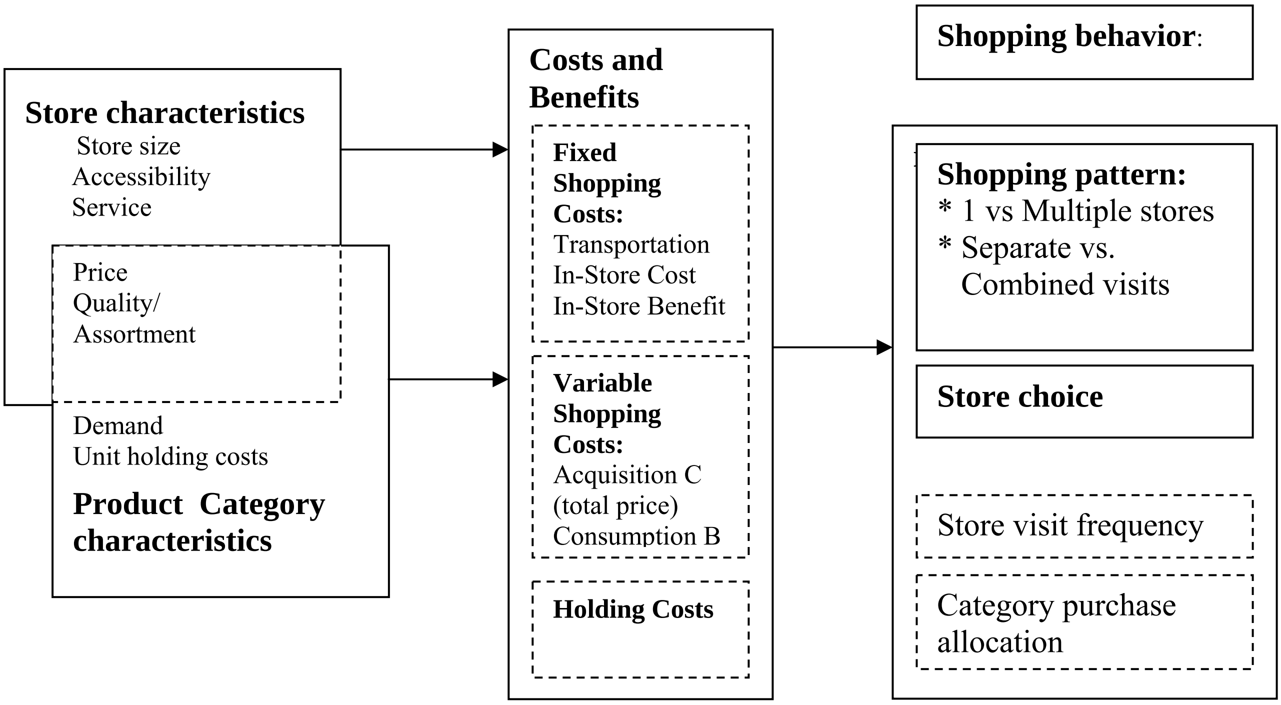

Figure 2: Store (pair) characteristics and MSS patterns

Fixed costs	Category-specific store preference		
	Uniform	Asymmetric	Complementary
Same	Single	Single	Single, separate or combined
Different	Single	Single or separate	Single, separate or combined

MSS based on Fixed Cost Complementarity

MSS based on Category Preference Complementarity

Figure 3: Average share in total expenditures for different types of shopping patterns and store formats